

CLAIMS

I claim:

1. A linear incendiary strand comprising:
a solid or semi-solid fuel component;
rapid linear ignition means; and
reinforcing means.
2. The linear incendiary strand of claim 1, wherein the fuel component is selected from the group consisting of waxes, tars, natural resins, latex rubbers, gelled hydrocarbons, polyethylene, polypropylene, poly-isoprene, poly-butadiene, and silicon rubber.
3. The linear incendiary strand of claim 2, wherein the fuel component further comprises a filler.
4. The linear incendiary strand of claim 3, wherein the filler comprises cellulose fibers.
5. The linear incendiary strand of claim 4, wherein the filler is selected from the group consisting of sawdust, wood pulp, cotton linters, and ground vegetative matter.
6. The linear incendiary strand of claim 3, wherein the filler is sawdust fibers derived from the western red cedar tree.
7. The linear incendiary strand of claim 1, wherein the fuel component is a composition comprising conifer tree resins.
8. The linear incendiary strand of claim 1, wherein the fuel component is comprised of a combustible thermoplastic resin in homogenous admixture with cellulose fiber particles that have been impregnated with an oxidizing agent.
9. The linear incendiary strand of claim 8, wherein the thermoplastic resin is a mixture of a pine resin derivative, cellulose acetate butyrate, and a plasticizing agent.
10. The linear incendiary strand of claim 9, wherein the plasticizing agent is selected from the group consisting of glyceryl triacetate, butyl ricinoleate and triethyl citrate.
11. The linear incendiary strand of claim 1, wherein the fuel component sustains burning at any point along the strand for a period of time sufficient to raise the temperature of nearby vegetative matter to the point of ignition.

12. The linear incendiary strand of claim 1, wherein the fuel component exhibits flaming combustion for a duration of from ten seconds to five minutes, as measured at any point along the length of the strand.

13. The linear incendiary strand of claim 1, wherein the rapid linear ignition means comprises an elongate pyrotechnic element.

14. The linear incendiary strand of claim 13, wherein the elongate pyrotechnic element is confined within the interior of an elongate close-fitting conduit.

15. The linear incendiary strand of claim 13, wherein the elongate pyrotechnic element is arranged centrally in a channel defined by other structural elements of the strand.

16. The linear incendiary strand of claim 13, wherein the fuel component comprises one or more planiform layer(s) of combustible thermoplastic resin, and wherein the fuel component and elongate pyrotechnic element are laminated between an upper covering layer and a lower covering layer to form a tape.

17. The linear incendiary strand of claim 16, wherein the fuel component layer of the tape is in a discontinuous pattern on both upper and lower surfaces of the pyrotechnic element in order to form a central longitudinal gas channel in connective arrangement with multiple lateral gas channels.

18. The linear incendiary strand of claim 17, wherein the lateral gas channels are open to the exterior lateral edges of the tape and are longitudinally offset to either side of the longitudinal gas channel.

19. The linear incendiary strand of claim 1, further comprising a longitudinal gas channel.

20. The linear incendiary strand of claim 19, wherein the interior surface of the gas channel comprises the fuel component.

21. The linear incendiary strand of claim 19, wherein the gas channel is covered by an exterior sheath.

22. The linear incendiary strand of claim 21, wherein the exterior sheath is selected from the group consisting of paper, plastic film, or coated fabric compositions.

23. The linear incendiary strand of claim 13, wherein the pyrotechnic element comprises an extruded strand formed from a mixture of an oxidizing agent, a fuel compound and a binder.

24. The linear incendiary strand of claim 23, wherein the binder is selected from the group consisting of cellulose nitrate, cellulose acetate, polyacrylate, polyisoprene, polybutadiene, polyethylene and polypropylene.

25. The linear incendiary strand of claim 23, wherein the binder is cellulose acetate butyrate.

26. The linear incendiary strand of claim 13, wherein the pyrotechnic element comprises a cellulose fiber substrate that is impregnated and coated with a pyrotechnic composition comprised of oxidizer and fuel compounds.

27. The linear incendiary strand of claim 26, wherein the cellulose fiber substrate is paper.

28. The linear incendiary strand of claim 26, wherein the cellulose fiber substrate is a loose woven cotton textile fabric.

29. The linear incendiary strand of claim 26, wherein the pyrotechnic composition comprises ammonium perchlorate, potassium perchlorate, powdered aluminum, 325 mesh, and binder.

30. The linear incendiary strand of claim 13, further comprising a longitudinal gas channel, wherein the interior surface of the gas channel comprises the fuel component, wherein the pyrotechnic element comprises a fabric substrate with a coating of pyrotechnic composition positioned centrally within the gas channel, and wherein the lateral edges of the pyrotechnic element are fixedly embedded in the fuel component along the longitudinal axis of the incendiary strand.

31. The linear incendiary strand of claim 30, further comprising a plurality of vent passages that are radially disposed about the circumference of the strand and that are arranged at equidistance intervals along the strand.

32. The linear incendiary strand of claim 1, wherein the reinforcing means comprises an exterior sheath.

33. The linear incendiary strand of claim 1, wherein the reinforcing means comprises a continuous textile substrate.

34. The linear incendiary strand of claim 1, wherein the reinforcing means comprises elongate fiber particles in a structural composite matrix.
35. The linear incendiary strand of claim 1, further comprising means for fragmenting the strand subsequent to ignition.
36. The linear incendiary strand of claim 35, wherein the means for fragmenting the strand subsequent to ignition comprises rapidly burning longitudinal reinforcing elements placed at selective intervals along the strand.
37. The linear incendiary strand of claim 35, wherein the means for fragmenting the strand subsequent to ignition comprises vent passages that cause the strand to melt and separate into individually burning pieces.
38. The linear incendiary strand of claim 1, wherein the strand is in the form of a tape.
39. The linear incendiary strand of claim 1, wherein the strand is in the form of a ribbon.
40. The linear incendiary strand of claim 1, wherein the strand is in the form of a cord.
41. The linear incendiary strand of claim 1, wherein the strand is in the form of a tube.
42. The linear incendiary strand of claim 1, wherein the strand is in the form of a filament.
43. The linear incendiary strand of claim 1, wherein the strand can be wound upon a spool of suitable diameter for handheld deployment.
44. The linear incendiary strand of claim 1, further comprising weatherproofing means.
45. The linear incendiary strand of claim 44, wherein the weatherproofing means comprises water-resistant coatings.
46. The incendiary strand of claim 44, wherein the weatherproofing means comprises water-resistant compositions.
47. A method of igniting vegetative matter over an area of land using the linear incendiary strand of claim 1, comprising the steps of:

laying out one or more linear incendiary strand(s) in a predetermined pattern throughout the area to be burned; and

igniting each incendiary strand in succession at intervals of time selected to achieve the desired fire behavior characteristics.

48. A method of setting backfires in wildfire control activities using the linear incendiary strand of claim 1, comprising the steps of:

placing a first linear incendiary strand among combustible vegetative matter adjacent to fire control lines in the path of an advancing wildfire; and

igniting the first linear incendiary strand either by direct application of flame or by electrical activation.

49. The method of claim 48, further comprising the steps of:

placing additional linear incendiary strands along strips parallel in orientation to the first linear incendiary strand, at a distance of spacing between strips that is determined according to fuel, weather and topographical conditions; and

igniting the additional incendiary strands in a sequence timed to result in a line of fire being drawn from the control line outwardly toward the advancing wildfire and against the direction of the prevailing winds.

50. The method of claim 49, further comprising igniting the incendiary strands precisely at the onset of indraft winds generated from the advancing wildfire.

51. A method of producing the pyrotechnical element of the linear incendiary strand of claim 30, wherein the pyrotechnical element is produced by:

soaking the fabric substrate in a saturated aqueous solution of a water-soluble oxidizing agent;

squeezing the fabric to remove excess solution;

drying the fabric in a warm air drying tunnel;

coating the fabric with a rapidly burning pyrotechnic composition;

drying the fabric; and

cutting the fabric into strips.

52. The method of claim 51, wherein the fabric substrate is bleached cotton cheesecloth.

53. The method of claim 51, wherein the rapidly burning pyrotechnic composition comprises ammonium perchlorate, potassium perchlorate, powdered aluminum, 325 mesh, and a binder.

54. The method of claim 53, wherein the binder is prepared by dissolving nitrocellulose solids in acetone in increments until the solution is viscous and heavy-bodied.

55. A method of manufacturing the linear incendiary strand of claim 12, comprising the following steps:

heating a combustible thermoplastic resin to a temperature of 200 degrees C.;

soaking cedar sawdust fibers in a saturated aqueous solution of a water-soluble oxidizing agent;

drying the cedar sawdust fibers;

adding the cedar sawdust fibers to the hot thermoplastic resin in increments at a temperature of about 150 degrees C. until the thermoplastic resin has a thick, dough-like consistency;

forming the thermoplastic resin into the shape of a hollow strand with the pyrotechnic element embedded within a portion of its interior walls using a cross-head extrusion technique;

cooling the strand; and

perforating or drilling vent passages into the strand.

56. The method of claim 55, further comprising the step of applying a weatherproofing layer to the outside of the hollow strand by passing it quickly through an immersion bath of a melted thermoplastic polymer and rapidly cooling it in a coolant bath.

57. The method of claim 56, wherein the melted thermoplastic polymer is plasticized cellulose acetate butyrate.

58. The method of claim 55, further comprising the step of applying a weatherproofing layer to the outside of the hollow strand by spiral wrapping an adhesive-backed cellulose acetate film around the strand's outer surface.

59. The method of claim 55, wherein the combustible thermoplastic resin comprises pine resin derivative, cellulose acetate butyrate, and a plasticizing agent.

60. The method of claim 59, wherein the plasticizing agent is selected from the group consisting of glyceryl triacetate, butyl ricinoleate and triethyl citrate.

61. The method of claims 51 or 55, wherein the water-soluble oxidizing agent is ammonium perchlorate.

62. The method of claims 51 or 55, wherein the water-soluble oxidizing agent is potassium nitrate.

63. A method of manufacturing the linear incendiary strand of claim 1, comprising the steps of:

heating a combustible thermoplastic resin to form the fuel component; and

laminating an upper covering layer and a lower covering layer together with a fuel component layer and a pyrotechnic element to form a tape,

wherein the fuel component layer is in a discontinuous pattern on both upper and lower surfaces of the pyrotechnic element in order to form a central longitudinal gas channel in connective arrangement with multiple lateral gas channels, and

wherein the lateral gas channels are open to the exterior lateral edges of the tape and are longitudinally offset to either side of the longitudinal gas channel.

64. The method of claim 63, wherein the pyrotechnic element is produced in the same manner as set forth in claim 51.

65. The method of claim 63, wherein lamination of the upper covering layer, lower covering layer, fuel component layer and pyrotechnic element comprises the following steps:

mounting spools of upper covering layer and lower covering layer on separate feed spindles of a roll laminating apparatus;

mounting a spool of pyrotechnic element on a feed spindle between the spools of upper and lower covering layers;

drawing the pyrotechnic element through a double-sided slot-die extrusion apparatus comprising two separate slot die extrusion heads on each side of the pyrotechnic element;

arranging the extrusion heads to apply two separated strips of heated thermoplastic fuel component to each side of the pyrotechnic element to a thickness of about 20 mils per side;

modulating the flow from each extrusion head by linear indexing means to provide discontinuous strips longitudinally; and

drawing the upper and lower covering layers together with the coated pyrotechnic element and feeding the layers through suitably spaced pressure rollers to form a permanent lamination.

66. The method of claim 65, wherein the total thickness of the laminated layers is about 60 mils.

67. The method of claim 65, wherein the upper and lower covering layers are made of polymeric film.

68. The method of claim 65, wherein the upper and lower covering layers are made of coated fabric.

69. The method of claim 65, wherein the upper and lower covering layers are made of paper.

70. The method of claim 65, wherein the upper and lower covering layers are made of creped kraft paper impregnated with an oxidizing agent.

71. The method of claim 70, wherein the creped kraft paper is impregnated with an oxidizing agent by:

soaking the paper in a saturated aqueous solution of an oxidizing agent; and drying the paper.

72. The method of claim 71, wherein the creped kraft paper is soaked in the oxidizing agent solution at the same time that it is subject to the wet creping process used to produce the creped paper.

73. The method of claim 70, wherein the creped kraft paper is further impregnated and coated with a waterproofing agent.

74. The method of claim 73, wherein the waterproofing agent is a cellulose acetate butyrate lacquer.

75. The method of claim 73, wherein the waterproofing agent is a non-petroleum-based microcrystalline wax solution.